
Space Weather Technical Forecast

Issued on Saturday, 05 August 2023 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: G1-G2 Minor/Moderate storm likely at times from CME arrivals. R1-R2 Radio blackouts possible. S1/Minor Radiation Storm easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two M-class flares observed. The largest was an M2.1 likely from AR3380 over the west limb peaking 05/0936 UTC. The second was a long period M1.6 from AR3386, peaking 05/0719 UTC. There are eight sunspot regions feature on the visible disc. AR3386 is the most notable and largest region, as a compact pair of opposite polarity spots, with surrounding smaller spots leading to some increased complexity. Otherwise the sunspots on the disc are small and simple, and generally either stable or weakening. The M1.6 flare of AR3386 produced a CME that is still undergoing analysis, but is unlikely to have a significant Earth-directed component given its location.

Solar Wind / Geomagnetic Activity: ACE/DSCOVR observed a CME arrive at L1 at 05/0209 UTC, likely the early arrival of a CME that was anticipated to arrive on 06 Aug. This showed a small increase in wind speeds from background levels of 380km/s to 450km/s, before easing again. Density increased from average levels to above average, peaking 30 ppcc. The total interplanetary magnetic field strength (Bt) was Moderate to Strong at 8-15nT, due to the previous CME arrival on 04 Aug, but then increased to be Strong at 15-25nT between 05/0220-0800 UTC in response to the new CME arrival, before easing to be Moderate at the end of the period. The north-south component, (Bz) was generally southward (negative) with minimum value of -22nT at 05/0232 UTC, before easing, with brief positive (northward) orientated periods. Geomagnetic activity was Unsettled to Active, but G1-G2 Minor/Moderate Storm 05/0000-0900 UTC due the CME arrival.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux rose from background levels to peak at S1 Minor Radiation Storm from 05/1115 UTC. This was due to the M1.6 flare of AR3386 at 05/0719 UTC. GOES16 high energy (greater than 2MeV) electron flux was at background levels throughout. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu), with 1.39e6 integrated pfu noted at 05/0000UTC.

Four-Day Space Weather Forecast Summary

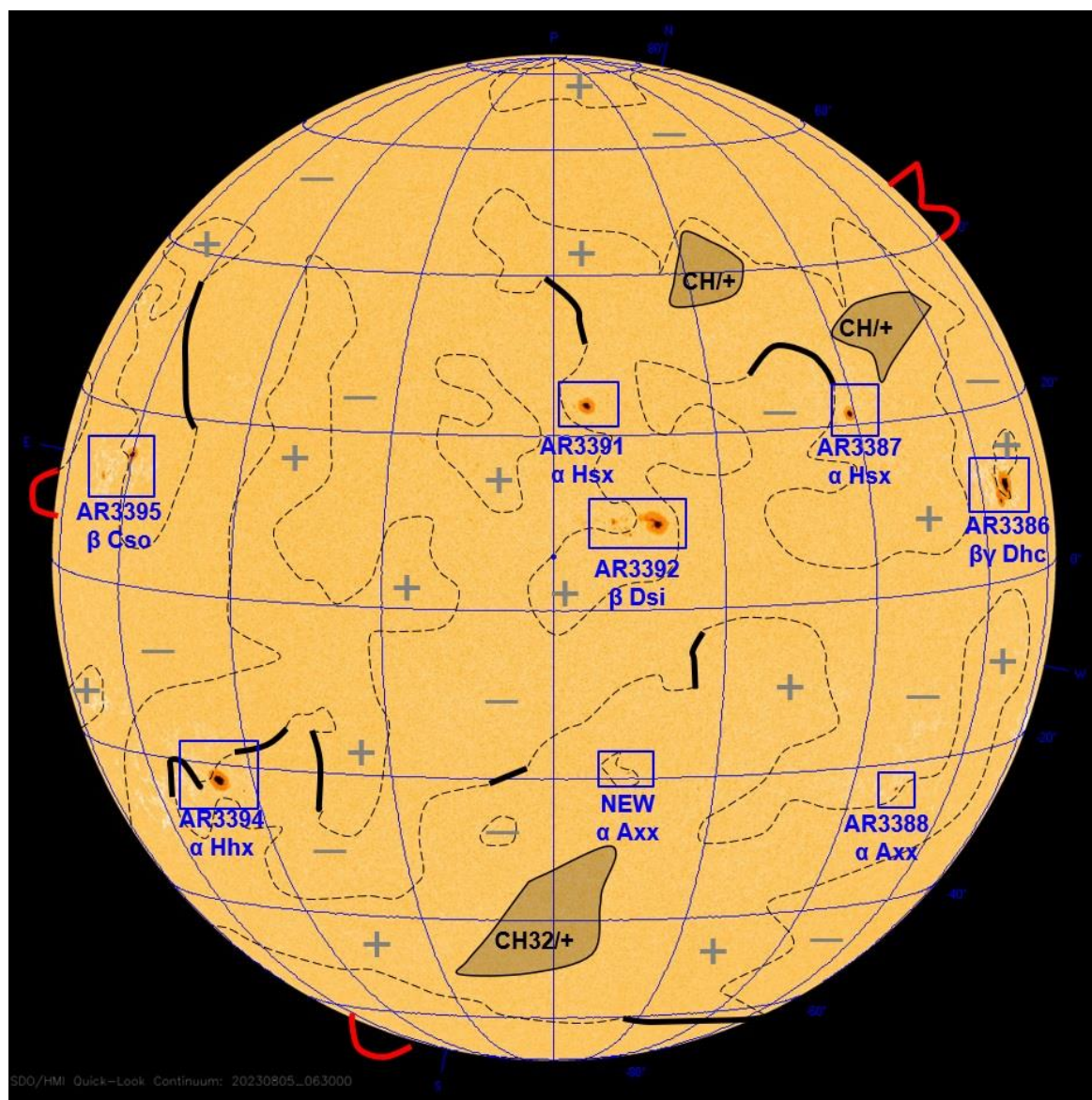
Solar Activity: Activity is likely to be Low to Moderate, with a chance of isolated M-flares, mainly from AR3386 in the northwest. This risk decreases day 3 and 4 (07 and 08 Aug) as this region rotates off the visible disc.

Solar Wind / Geomagnetic Activity: Further CME influence is possible day 1 from ongoing CME arrival. Next CME enhancement is likely to be day 3 or day 4 (07 or 08 Aug) from the M2.0 flare and filament lift on 04 Aug, although this is low confidence and analysis continues on this complex eruption. Overall geomagnetic activity is likely to ease from its initially disturbed conditions to be mainly Quiet, with isolated Unsettled spells day 2 (06 Aug). However further CME arrivals, will increase this again to Active to G2 Moderate Storms for periods on day 3 or day 4 (07-08 Aug).

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Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to gradually ease from its current values, below the S1 threshold. There is a slight, but decreasing chance of further enhancements due to AR3386. The high energy electron flux (greater than 10 MeV) has the potential to briefly become enhanced later day 1-day 3 (05-07 Aug) as current CME influence recedes, however this will be suppressed by any further CME arrivals. The associated fluence likely remaining below the Active threshold (1e8 total pfu), but with a slight chance of rising above, mainly later day 2 or day 3.

Figure 1. Solar Analysis Valid 05/08000 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

CME arrival on 05 Aug has currently been attributed to an early arrival of the CME which left the Sun around 02/0900 UTC due to a filament eruption near centre-disc. Ongoing enhancement from this CME remains possible day 1 (05 Aug) with further G1-G2 Minor to Moderate storm intervals possible. A general trend of easing towards Quiet to Unsettled is expected however, into or early on day 2 (06 Aug), with solar winds also likely easing to background. There remains some uncertainty with this current attribution of the CME, and further enhancement is possible later day 1 or early day 2, should another arrival occur.

Further CME arrival(s) are then possible later in the period. This has previously been forecast day 3 (07 Aug), although looking increasingly like a mainly glancing impact. This CME was due to a complex eruption from the northwest disc which occurred 04/0430 UTC due to the M2.0 flare of AR3386, rapidly followed at 05/0530 UTC by a filament lift just to the southeast of AR3386. Consequently this is now being revaluated as two separate CMEs, and a further enhancement cannot be ruled out later day 3 or into day 4 (08 Aug). This will bring a further chance of Active to G1 Minor Storm intervals, and a chance of G2 Moderate Storms. There is a slight chance of G3 Strong Storms.

A further CME has also been observed due to the long period M1.6 flare of AR3386 at 05/0719 UTC, and is still under analysis. There coronal holes currently on the disc are not expected to bring anything more than slight enhancements to the otherwise CME dominated or background solar wind.

Overall geomagnetic activity is likely to ease from its initially disturbed conditions to be mainly Quiet, with isolated Unsettled spells day 2 (06 Aug). However further CME arrivals, will increase this again to Active to G2 Moderate Storms for periods on day 3 or day 4 (07-08 Aug).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	70	20	60	40
Strong	G3	No	1	1	10	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

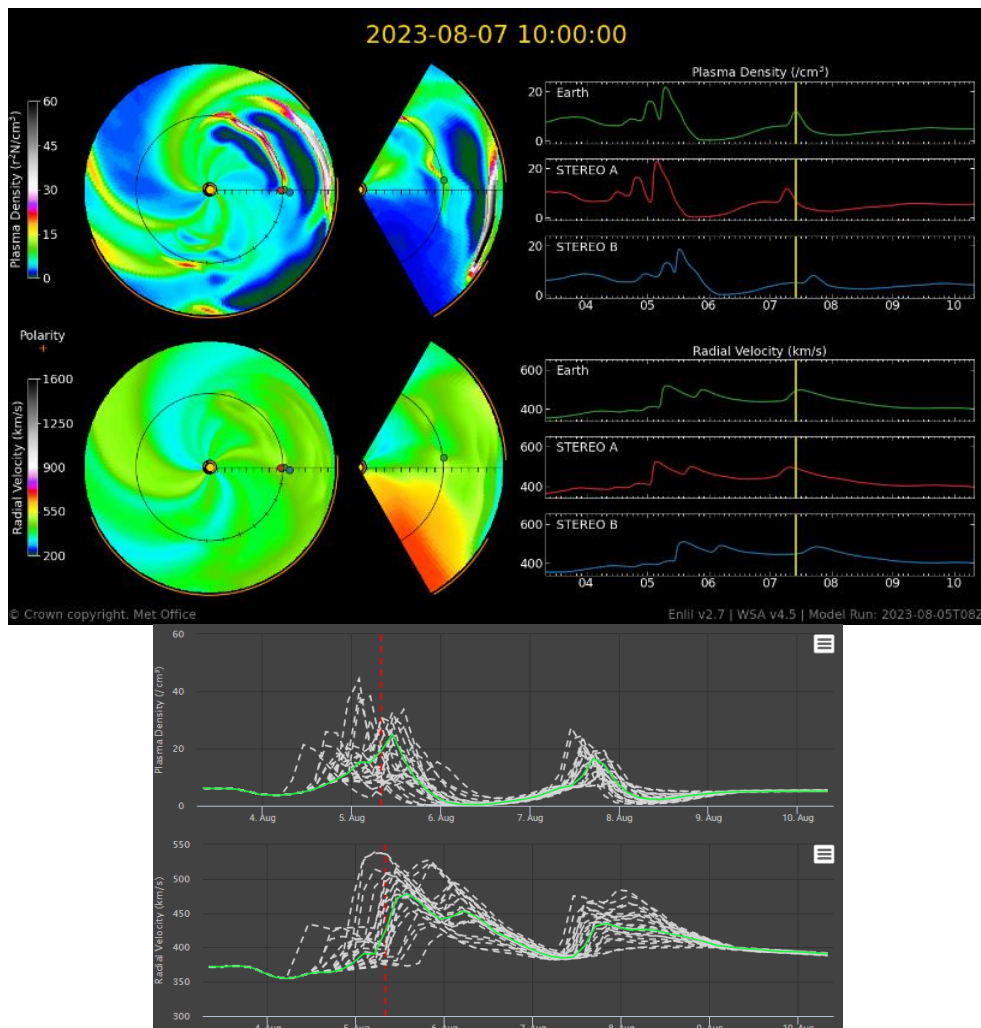
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/1000	Partial Halo	M2.0	NE	930	04/0700 UTC	Flare part of CME reanalysed
04/10:23	Partial Halo	Filament	NE	595	04/1023 UTC	Filament portion of CME.

Figure 2a: L1 observed solar wind speed



Figure 2b: Enlil showing likely arrival on 07 Aug and ensemble showing uncertainty



Radio Blackouts - X-Ray Flares:

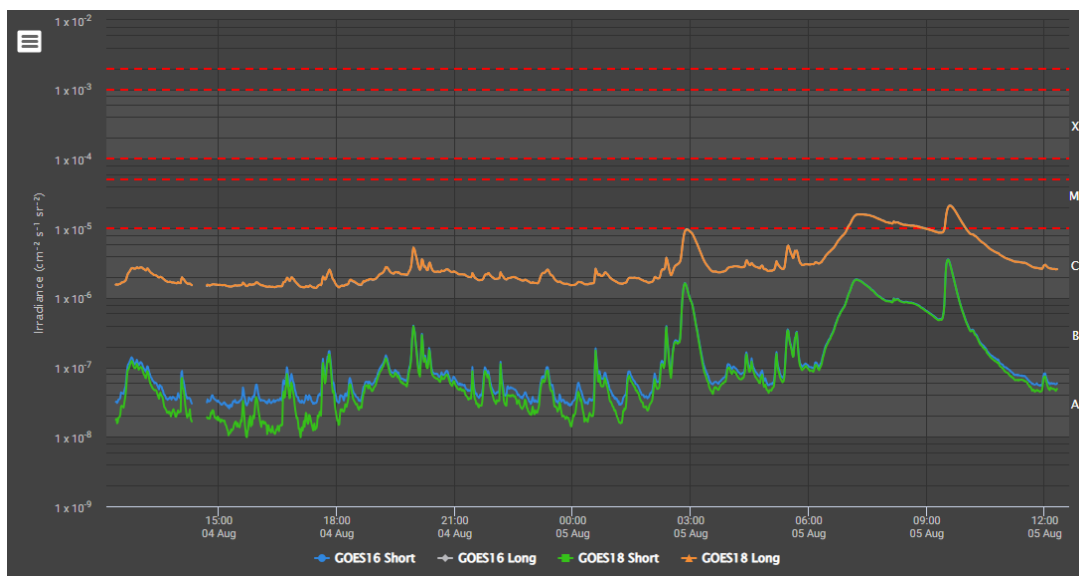
Activity is currently Moderate, with two M-flares in the last 24 hours. Peak flare was M2.1, likely from AR3380, now over the west limb. A long period M1.6 was also observed from AR3386. This is a compact region, primarily composed of two moderately sized spots, but with surrounding small spots leading to some increased complexity. Motion is also evident between the two spots, and This has on ongoing potential for similar flares, before rotating off the visible disc through later day 2 (06 Aug).

The other seven regions currently on the disc are all relatively stable, and either mature unipolar regions, or smaller bipolar regions. The largest of these is AR3394 in the southeast, however this is currently a simple unipolar spot set amongst a large area of plage. Meanwhile AR3387 in the northwest has seen some growth of small spots to become a bipolar region, however this remains relatively simple.

Further M-flares are likely but with a decreasing risk as AR3386 rotates off the disc, with Activity remaining Moderate to Low.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	50	30	30
Very Active	R3 to R5 X Class	No	5	5	1	1

Figure 3: GOES-16/18 X-ray Flux



Solar Radiation Storms - (High Energy Protons):

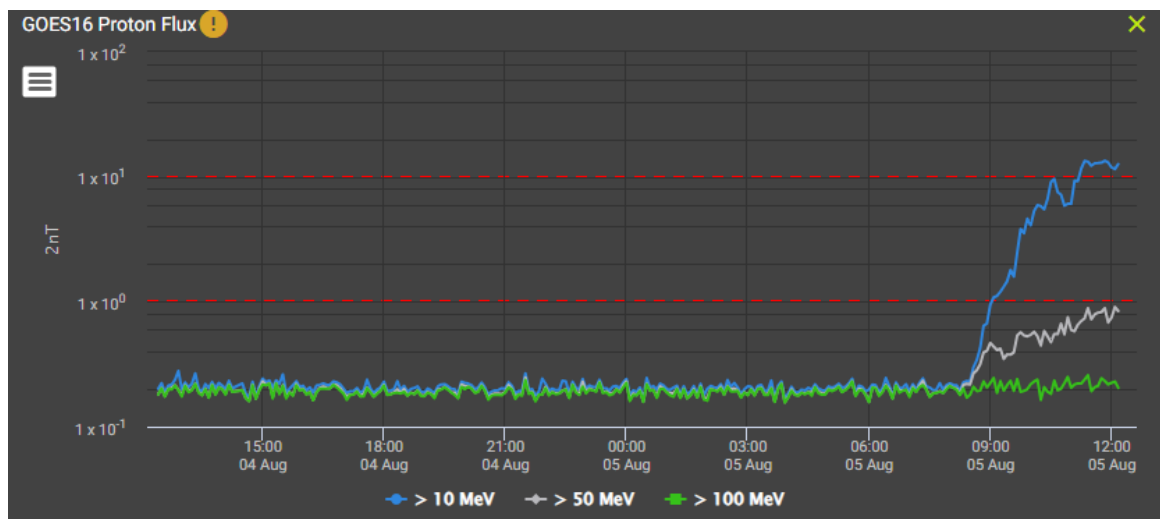
The high energy (greater than 10 MeV) proton flux is currently around the S1 Minor Storm Level, due to the long period M1.6 flare of AR3386 on the northwest disc. These values are likely to soon peak, before gradually declining through the rest of day 1, likely falling below the S1 Minor Storm level by the end of the day.

There remains a slight chance of further enhancement due to any further large flares from AR3386. This risk decreases through day 3, as the region will move further away from Earth on the far-side. Otherwise the proton flux is expected to gradually ease towards background, with the other sunspot regions on the disc currently unlikely to produce significant proton enhancements.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	Yes	100	20	10	5
Very Active	$\geq \text{S3}^*$	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 4: GOES 16 >10MeV, >50 MeV and >100 MeV Proton Flux



High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 10 MeV) observed by GOES16 is currently at background, but likely became enhanced at lower orbits with the recent CME arrival. As any CME influence recedes day 1 into day 2 (05-06 Aug), flux is likely to rapidly rise. The extent and persistence of any such rise is very low confidence however, with the potential for further CME arrivals. These most likely on day 3 (07 Aug) with effect continuing into day 4 (08 Aug). Any such arrivals are likely to cause a drop out in observed flux, at least for the period of increased solar wind pressure, before flux potentially rises again as the CME influence recedes. A further complication to the forecast is the current slight proton enhancement, which has the potential to contaminate the observations.

Overall, the associated 24 hour fluence is likely to stay below the Active level, however there is a chance of this rising above, mainly late day 2 or early day 3 (06-07 Aug), before any subsequent CME arrival. REFM is likely to be unreliable in this period, due to the potential CME arrivals.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	30	30	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1